Amendments to the Claims

The listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

1. (currently amended) Apparatus for measuring displacement ~~that scans radiated light on the~~ of a surface of a measuring object ~~and measures the amount of displacement of the surface of the measuring object without contact based upon the detected position of an image formation point formed on a light receiving plane of a light receiving element~~, comprising:

projecting means having one convergent lens, said projecting means scanning ~~that scans~~ radiated light on the surface of the measuring object through the convergent lens to form an irradiation point on the surface of the measuring object; and

light receiving means including a light receiving element with a light receiving plane ~~that receives~~ for receiving measuring beams ~~from~~ reflected at the irradiation point ~~on the light receiving plane of the light receiving element and forms~~ to form an image formation point on the light receiving plane, ~~wherein: the light receiving means comprises:~~ a lens array ~~which is~~ composed of plural condenser lenses having a uniform image formation characteristic around ~~the~~ an optical axis thereof~~, in which the plural condenser lenses are~~ and arranged in a scanning direction ~~scanned by~~ of the radiated light ~~and which converges~~ for converging the measuring beams reflected at the irradiation point, [[;]] and an imaging lens ~~that has~~ having a uniform image formation characteristic around ~~the~~ an optical axis thereof ~~and converges~~ for converging the measuring beams passing through the lens array to form the image formation point on the light receiving plane so that an amount of the displacement on the surface of the measuring object is obtained by using triangulation of light reflected on the surface of the measuring object after passing though said one convergent lens, passing through said lens array and imaging lens, and forming the image formation point on the light receiving plane, and a signal

different according to a location of the image formation point on the light receiving plane.

2. (currently amended) Apparatus for measuring displacement according to Claim 1, wherein[[:]]

the light receiving element is provided in a position apart by ~~the~~ a focal length from the imaging lens.

3. (currently amended) Apparatus for measuring displacement according to Claim 1, wherein[[:]]

~~each optical axis of~~ the plural condenser lenses ~~is~~ have mutually parallel optical axes [[;]] and ~~the plural condenser lenses~~ are arranged in parallel in a position apart by ~~the~~ a focal length from the irradiation point in a line orthogonal to each optical axis ~~and form the lens array~~.

4. (currently amended) Apparatus for measuring displacement according to Claim 1, wherein[[:]]

~~relationship in arrangement among~~ the lens array, the imaging lens and the light receiving element ~~is~~ have a relationship expressed by an expression $0 < (f2/f1) \cdot t < w$[[.]] ,

~~However,~~ wherein w ~~means the~~ is a light receiving width parallel with ~~the~~ a direction of a scan of the light receiving plane, t ~~means the~~ is a width parallel with the scanning direction ~~of a scan~~ of each condenser lens, f1 ~~means the~~ is a focal length of the condenser lens and f2 ~~means the~~ is a focal length of the imaging lens.

5. (currently amended) Apparatus for measuring displacement according to Claim 1, wherein[[:]]

the projecting means ~~makes~~ scans the ~~scanned~~ radiated light ~~vertically incident on~~ perpendicular to the surface of the measuring object to form ~~an~~ the irradiation point; and

~~a pair of~~ the light receiving means ~~are~~ includes a pair of light receiving units provided at an equal distance from the

irradiation point in symmetrical positions from ~~the~~ an optical path plane of the ~~scanned~~ radiated light.

6. (currently amended) Apparatus for measuring displacement according to Claim 5, further comprising[[:]]

displacement operation means that operates and outputs a displacement signal of the surface of the measuring object based upon ~~the~~ a position of the image formation point formed on each light receiving plane of the pair of the light receiving ~~elements~~ units.

7. (currently amended) Apparatus for measuring displacement according to Claim 6, wherein[[:]]

the displacement operation means comprises[[:]]

two preadders that respectively add a pair of electric signals acquired from symmetrical positions ~~from~~ relative to the optical path plane of the ~~scanned~~ radiated light after four electric signals ~~acquired~~ corresponding to ~~an~~ the position of image formation ~~position~~ point on the each light receiving plane of the pair of the light receiving ~~elements~~ units are respectively converted from current to voltage;

an adder that adds each electric signal acquired in the preadders;

a subtracter that subtracts an electric signal acquired in one of the preadders from an electric signal acquired in the other of the preadders; and

a divider that divides an electric signal acquired in the subtracter by an electric signal acquired in the adder.

8. (currently amended) Apparatus for measuring displacement according to Claim 6, wherein[[:]]

the displacement operation means comprises an adder and a subtracter ~~in every~~ for each of the light receiving ~~means:~~ units,

said adder adding a pair of electric signals after the pair of the electric signals ~~acquired~~ corresponding to ~~an~~ the position of the image formation ~~position~~ point on the each light receiving

plane of the light receiving ~~element~~ units ~~are~~ is respectively converted from current to voltage~~; and~~,

said subtracter subtracting one of the pair of the electric signals from the other;

an addition signal adder that adds addition signals acquired from each adder;

a subtraction signal adder that adds subtraction signals acquired from each subtracter; and

a divider that divides an electric signal acquired in the subtraction signal adder by an electric signal acquired in the addition signal adder.

9. (currently amended) Apparatus for measuring displacement according to Claim 6, wherein[[:]]

the displacement operation means comprises an adder, a subtracter and a divider ~~in every~~ for each of the light receiving ~~means:~~ units,

said adder adding a pair of electric signals after the pair of the electric signals ~~acquired~~ corresponding to ~~an~~ the position of the image formation ~~position~~ point on the each light receiving plane of the light receiving ~~element~~ units ~~are~~ is respectively converted from current to voltage[[;]],

said subtracter subtracting one of the pair of the electric signals from the other; and

said divider dividing a subtraction signal acquired in the subtracter by an addition signal acquired in the adder;

switching means that receives each displacement signal corresponding to a divided value divided in the each divider and a displacement signal corresponding to ~~the~~ an average value of the divided values so as to switchably output one of the displacement ~~signal~~ signals;

level determination means that determines whether the each addition signal meets a predetermined reference value or not; and

selecting means that selectively outputs a suitable one of the each displacement signal input to the switching means by switching

based upon ~~the~~ a result of determination in the level determination means.

10. (currently amended) Apparatus for measuring displacement ~~that scans radiated light on the~~ of a surface of a measuring object ~~and measures the amount of displacement of the surface of the measuring object without contact based upon the detected position of an image formation point formed on the light receiving plane of a light receiving element~~, comprising:

projecting means that radiates light for scanning the light on the surface of the measuring object ~~and forming~~ to form an irradiation point on the surface of the measuring object;

light receiving means ~~that receives~~ including a light receiving element with a light receiving plane for receiving measuring beams from the irradiation point ~~on the light receiving plane of the light receiving element and forms~~ thereon to form an image formation point on the light receiving plane, ~~wherein: the light receiving means comprises:~~ a lens array ~~which is~~ composed of plural condenser lenses having a uniform image formation characteristic around ~~the~~ an optical axis thereof~~, in which the plural condenser lenses are~~ and arranged in a scanning direction ~~scanned by~~ of the radiated light ~~and which converges~~ for converging the measuring beams[[;]], and an imaging lens ~~that has~~ having a uniform image formation characteristic around ~~the~~ an optical axis thereof ~~and converges~~ for converging the measuring beams to form the image formation point on the light receiving plane;

displacement operation means that operates and outputs ~~the~~ an amount of the displacement of the surface of the measuring object based upon ~~the~~ a position of the image formation point formed on the light receiving plane of the light receiving element; ~~and~~

processing means that detects ~~the~~ a deviation of the image formation ~~position~~ point caused ~~because of the~~ by dispersion of the image formation ~~positions~~ point of light passed in the lens array in plural locations in ~~the~~ a direction of a scan, corrects and outputs the amount of the displacement of the surface of the measuring object based upon the detected deviation, said processing

means including deviation detection means for detecting the deviation of the image formation point using a reference object, correction value storage means for storing the deviation detected by the deviation detection means as correction data, and displacement correction means for correcting and outputting the amount of the displacement output from the displacement operation means based upon the correction data stored in the correction value storage means when the amount of the displacement of the surface of the measuring object is measured;

scan initiation detection means for outputting a scan initiation signal whenever the radiated light is scanned; and

counting means for counting a current position scanned by the radiated light based upon the scan initiation signal from the scan initiation detection means,

wherein said deviation detection means correlates the deviation with the current position scanned by the radiated light output from the counting means and stores in correction value storage means as correction data, and said displacement correction means reads the correction data corresponding to the current position scanned by the radiated light output from the counting means from the correction value storage means and corrects the amount of the displacement output from the displacement operation means by the correction data.

11-13. (canceled)

14. (currently amended) A ~~displacement measuring~~ method for measuring displacement, comprising:

~~of~~ scanning ~~an irradiation point formed by~~ light ~~radiated toward the~~ on a surface of a measuring object through one convergent lens to form an irradiation point on the surface of the measuring object,

converging the light from the irradiation point by a lens array ~~which is~~ composed of plural condenser lenses having a uniform image formation characteristic around ~~the~~ an optical axis thereof

and ~~in which the plural condenser lenses are~~ arranged in ~~the~~ a scanning direction of ~~a scan by~~ the ~~radiated~~ light,

forming an image formation point on a light receiving plane of a light receiving element by an imaging lens,

detecting a deviation of the image formation point on the light receiving plane of the light receiving element by using a reference object,

correcting an amount of the displacement based upon the deviation, and

measuring the amount of the displacement of the surface of the measuring object using triangulation of light without contact based upon the deviation of ~~an~~ the image formation ~~position~~ point ~~caused because of the dispersion of the positions of image formation points~~ on the light receiving plane ~~by forming an image formation point on the light receiving plane of a light receiving element, which comprises:~~

~~detecting the deviation of the image formation position on the light receiving plane of the light receiving element of each point in the direction of a scan of the surface of the measuring object by using a reference object beforehand; and~~

~~respectively correcting the amount of displacement at each point in the direction of a scan acquired in measuring the measuring object based upon the detected deviation~~.

15. (currently amended) A ~~displacement measuring~~ method according to Claim 14, ~~wherein:~~ further comprising

detecting a scan position of the ~~radiated~~ light by counting time since the scan is started~~; and using the detected scan position~~ for detecting the deviation and ~~for correction~~ correcting the amount of the displacement.

16. (new) Apparatus for measuring displacement of a surface of a measuring object, comprising:

a light source for irradiating light,

a deflector disposed between the light source and the measuring object for deflecting the light from the light source to

scan the light on the surface of the measuring object at a first angle relative to the surface,

a convergent lens disposed between the light source and the measuring object for converging the light from the deflector on the surface of the measuring object with the first angle,

a lens array formed of plural condenser lenses and arranged in a line for converging the light reflected from the surface of the measuring object at a second angle relative to the surface different from the first angle,

an imaging lens for converging the light from the lens array, and

a light receiving element for receiving the light from the imaging lens converged at an image formation point on a light receiving plane thereof so that an amount of the displacement of the surface of the measuring object is obtained based upon a position of the image formation point formed on the light receiving plane using triangulation of light.

Amendments to the Drawings

The attached sheet of drawings includes changes to Figs. 4A to 4E, 5A and 5B, 19A to 19C, and 20 to 24. This sheet replaces the original sheet of drawings. In Figs. 4A to 4E, previously omitted figure numbers 4A to 4E have been added. In Figs. 5A and 5B, previously omitted figure numbers 5A and 5B have been added. In Figs. 19A to 19C, previously omitted figure numbers 19A to 19C have been added. In Figs. 20 to 24, previously omitted 'Prior Art' has been added. In Figs. 22A and 22B, previously omitted figure numbers 22A and 22B have been added.